Remarks

Claims 1-32 were originally filed in this application.

Claims 1, 6, 9, 11, 18, 19, 21, 28, and 30 are currently amended without introducing new matter.

Claims 2 and 20 are canceled without prejudice or disclaimer.

No new claims are added.

As a result, claims 1, 3-19, and 21-32 remain pending for examination, with claims 1, 6, 18, and 28 being independent claims.

No new matter has been added with any of the amendments and support therefor can be found throughout the specification, including at, for example, pages 6, 10, 11, 12, Examples 1-3, and the accompanying drawings as originally filed.

Rejections Under 35 U.S.C. § 103

Claims 1-32 are rejected under 35 U.S.C. § 103(a) as would have been obvious over the teaching of Sato in European Patent No. EP 1 172 145 B1 (hereinafter "Sato") in view of the teaching of Briggs in U.S. Patent No. 2,535,035 (hereinafter "Briggs") and the teaching of Bianchi *et al.* in U.S. Patent No. 4,830,732 (hereinafter "Bianchi").

Applicants disagree that the respective subject matter of each of claims 1-32 would have been obvious over the teaching of Sato in view of the teachings of Briggs and Bianchi. The rejection is improper because none of the references teaches or suggests each and every claimed element, alone or in combination. The alleged *prima facie* case of obviousness is also improper because one skilled in the art would not have had any reasonable expectation that the alleged combination would be successful.

In particular, the subject matter of independent claim 1 would not have been obvious over Sato in view of Briggs and Bianchi because none of the references teaches a water purification

apparatus comprising a cathode compartment, an anode compartment, and at least one ion-depleting compartment fluidly connected to the cathode compartment, and at least one ion-concentrating compartment fluidly connected to the anode compartment.

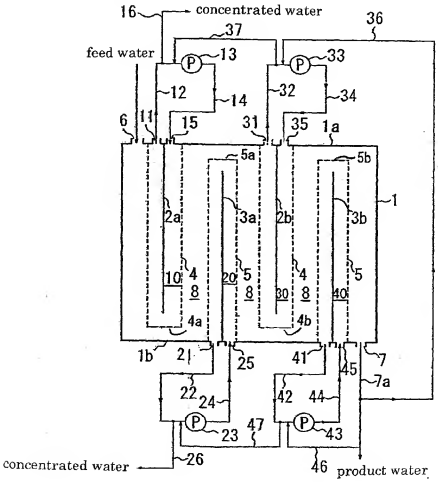
The subject matter of independent claim 6 would not have been obvious over these cited references because none of the references teaches a method of purifying a fluid comprising passing a first fluid through an ion-depleting compartment of an electrochemical device to produce a second fluid, passing at least a portion of the second fluid through a cathode compartment of the electrochemical device, passing a third fluid through an anode compartment of the device to produce an anolyte, and then passing the anolyte through at least one ion-concentrating compartment of the device.

The subject matter of independent claim 18 would not have been obvious over these cited references because the references do not teach a method of purifying water comprising passing a first portion of a first water stream through a cathode compartment of a water purification apparatus to produce a second water stream, passing at least a portion of the second water stream through at least one ion-depleting compartment to produce purified water, passing a second portion of the first water stream through at least one ion-concentrating compartment of the apparatus, then passing the second portion of the first water stream through an anode compartment of the apparatus, and reducing the LSI of the second portion of the first water stream.

The subject matter of independent claim 28 would not have been obvious because none of the cited references teaches a method comprising passing a first portion of a fluid through an ion-concentrating compartment of an electrochemical device to produce a second fluid, and reducing the pH of the second fluid, and reducing the corrosiveness of the third fluid, typically in a cathode compartment of the electrochemical device.

Sato teaches an electrodeionization apparatus and its method of operation and, in particular, teaches limiting the diffusion of silica from concentrating compartments of the device to produce product water with low silica concentration. (Sato at paragraphs [0006] to [0010], with reference to FIG. 1, reproduced below.)

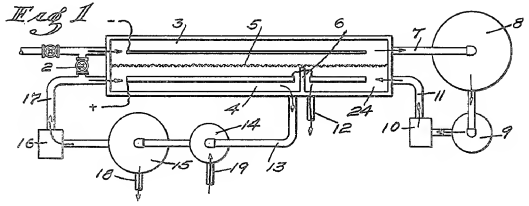
Fig. 1



Sato does not teach a device having an ion-concentrating compartment, and cannot teach a device having an ion-concentrating compartment fluidly connected to an anode compartment, a method comprising passing an anolyte stream into an ion-concentrating compartment of the device, nor a method comprising reducing the pH of a fluid from an ion-concentrating compartment in an anode compartment of an electrochemical device. Neither Briggs nor Bianchi corrects any of Sato's deficiencies. Indeed, as explained below, one skilled in the art would not

have utilized these references in combination that would have resulted in the respective subject matter recited each of claims 1, 3-19, and 21-32.

Briggs teaches a method of electrolytic water softening and pH adjustment and, in particular, teaches a method and a means of reducing the amount of waste solution involved in electrolytic water softening and, at the same time, serves to increase the efficiency of the electrolytic influence. (Briggs at column 1, lines 6 *et seq.*) Briggs explains that water bearing hardness ingredients is introduced a cathode chamber 3 and into an anode chamber 4, separated by a porous diaphragm 5. (Briggs at column 2, lines 13 et seq., with reference to FIG. 1, reproduced below) At cathode chamber 3, water becomes "alkalized" and the hardness ingredients are precipitated. (Briggs at column 2, lines 19 et seq.) Briggs electrolytically generates hydroxide species, OH^- in cathode chamber 3.



Bianchi discloses an electrochemical deoxygenation process for corrosion control in deionized water with a membrane electrolyzer. (Bianchi at Abstract.) The electrolyzer has electrolytic cells 1 defined by end-plates B. The cell 1 is separated into an anode compartment and a cathode compartment by a membrane M. The anode compartment has an anode A which supports the membrane M. (Bianchi at column 3, lines 1 *et seq.* with reference to the schematic illustration of FIG. 1, reproduced below.) The cathode compartment comprises a cathode C and a distributor D, which presses the cathode C against the membrane M. (Bianchi at column 3,

lines 27 *et seq.*) Deionized water is fed into the cathode compartment and a cathodic reaction reduces oxygen dissolved in the water. (Bianchi at column 4, lines 1 *et seq.*)

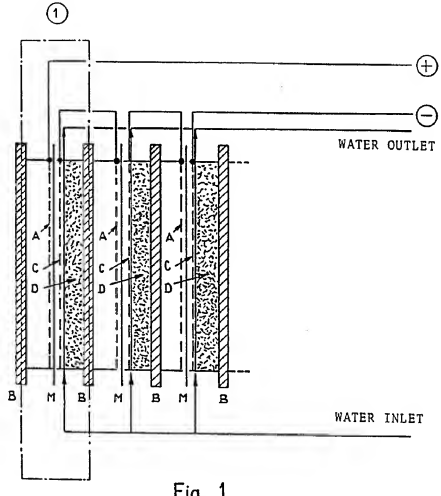


Fig. 1

Because Briggs and Bianchi fail to compensate for Sato's deficiencies, any combination of Sato, Briggs, and Bianchi would have failed to recite at least one element in claims 1, 3-19, and 21-32.

Further, a person of ordinary skill in the art would not have turned to the teaching of Bianchi to modify the teaching of Briggs or Sato. Contrary to the conclusory statements in the

final Office Action and the previous Office Action, no rational explanation has been provided that supports a motivation to incorporate the teaching of Bianchi that is directed to reactively removing dissolved oxygen by controlling an applied current through an electrolyzer. Indeed, because the device disclosed by Bianchi operates under principles that significantly differ from the operating principles of the device disclosed by Sato or even the device disclosed by Briggs, one skilled in the art would have recognized that the alleged combination would not have been reasonably expected to perform in any manner asserted.

As noted above, Bianchi seeks to remove dissolved oxygen from a deionized water stream by regulating an applied current and/or potential to an electrolyzer to a level that promotes reaction of the dissolved oxygen to produce water. In contrast, Briggs seeks to soften water having hardness species therein. Thus, a person skilled in the art would not have been motivated to modify Sato's allegedly typical electrodeionization device, or Briggs' electrolytic water softening device, to remove dissolved oxygen by controlling applied current. Further, one skilled in the art would not have been motivated to combine the differing principles of Briggs and Bianchi.

To be sure, a person skilled in the art would not have combined the teaching of Briggs with the teaching of Bianchi because the reactions disclosed in the cathode compartment of Briggs' device differ from those in the cathode compartment of the Bianchi device. Briggs teaches electrolytically raising the pH of the water in the cathode compartment, whereas Bianchi teaches electrolytically generating hydrogen ions in the cathode compartment, potentially lowering the pH of the deionized water therein. Thus, one skilled in the art would have recognized that applying the techniques disclosed by Briggs would render the device disclosed by Bianchi entirely inoperable. Conversely, one skilled in the art would also have recognized that applying the techniques disclosed by Bianchi would render the device disclosed by Briggs inoperable.

In particular and as explained above, Briggs teaches that water having hardness species is treated in a device by alkalizing, i.e., increasing hydroxyl ion concentration, in a cathode compartment of the device, thereby raising its pH.

Bianchi, in contrast, explains that deionized water is deoxygenated with hydrogen ion generated in a cathode compartment of the device. (Bianchi at column 3, lines 1-5, with reference to FIG. 1.) Bianchi further explains that reactions (I) and (II) occur at the cathode. (Bianchi at column 4, lines 1-5.)

(I) $O_2 + 4H^+ + 4e^- \rightarrow 2H_2O$

(II) $4H^+ + 4e^- \rightarrow 2H_2$

Reaction (III) occurs at the anode. (Bianchi at column 4, lines 5-7.)

(III) $2H_2O - 4e^- \rightarrow O_2 + 4H^+$

Clearly, Bianchi does not teach electrolytically producing hydroxyl ions, or even producing hydroxyl ions in the cathode compartment as presumed by the Examiner. Thus, because the cited references rely on different reaction schemes, one skilled in the art would have understood that combining Briggs and Bianchi would have resulted in a combination that would be inoperable for the respective intended purpose of these references.

The Examiner mischaracterizes Applicants' remarks as being "unclear how the references disclosing the electrolytic treatment of water at the electrodes can render one technique inoperable." Applicants clarify that because the references seek to treat different aspects of water, by different, conflicting approaches, the proposed combination of these references would have resulted in a non-operating device.

In the alternative, even if the teachings of the cited references could have been combined, one skilled in the art would have utilized the device of Bianchi to deoxygenate a deionized product from the device of Briggs. Plainly, the most plausible combination of these references would thus involve a water treatment system comprising (1) an electrolytic softener according to Briggs that produces softened, i.e., deionized water, and (2) a deoxygenating electrolyzer

according to Bianchi, downstream of the softener of Bianchi. The resultant combination of these references would not result in an apparatus or a method as claimed.

Therefore, the alleged *prima facie* case of obviousness is improper because the alleged combination would have failed to recite each and every limitation recited in each of independent claims 1, 6, 18, and 28. Further, the alleged *prima facie* case of obviousness is improper because, even if the teachings of the references could have been combined, one skilled in the art would not have had any reasonable expectation that the combination would have been successful nor would have resulted in the subject matter claimed.

For at least the same reasons mentioned above, the respective subject matter of each of the claims respectively dependent from independent claims 1, 6, 18, and 28 would also not have been obvious over the teaching of Sato in view of the teachings of Briggs and Bianchi.

Accordingly, reconsideration and withdrawal of the rejection of claims 1, 3-19, and 21-32 under 35 U.S.C. § 103 is respectfully requested.

Conclusion

In view of the foregoing Amendments and Remarks, this application is in condition for allowance; a notice to this effect is respectfully requested. If the examiner believes, after this amendment, that the application is not in condition for allowance, the examiner is requested to call Applicants' attorney at the telephone number listed below.

If this Response is not considered timely filed and if a request for an extension of time is otherwise absent, Applicants hereby request any necessary extension of time. If there is a fee occasioned by this Response, including an extension fee that is not covered by an enclosed check, please charge any deficiency to Deposit Account No. 50/2762.

Respectfully submitted,
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